Massachusetts Institute of Technology HHMI
StarGenetics

Name: _____

Mendel's Peas Exercise 1- Part 3

ISOLATING TRUE-BREEDING STRAINS

Goal

In this exercise you will use StarGenetics, a genetics experiment simulator, to design a set of experiments that will allow you to identify and isolate a true-breeding strain.

Prerequisite knowledge

Before completing this exercise, students should complete **Exercise 1 - Parts 1** and **2** and should be able to:

1. Explain important genetic terms including: allele, genotype, phenotype, dominant, recessive, homozygous, heterozygous, and true breeding.
2. Implement genetics experiments in the genetics cross simulator, StarGenetics.
3. Determine if an organism is true breeding through the analysis of results from genetic crosses.
4. Determine whether a phenotype is dominant or recessive relative to another phenotype.
5. Infer and assign genotypes of individual organisms using proper nomenclature of alleles.
6. Use Punnett Squares to predict and confirm expected genotypic and phenotypic ratios.

Learning objectives

After completing this exercise, you will be able to:

1. Design an experimental strategy to isolate organisms with a specific genotype
2. Design an experimental strategy to isolate a true-breeding strain.

Getting started with StarGenetics

- To access StarGenetics, please navigate to: **http://star.mit.edu/genetics/**.
- Click on the **Start** button to launch the application.
- Click **Trust** when a prompt appears asking if you trust the certificate.
- Click on **File** → **New** in the drop-down menu in the upper left hand corner.
- Click on the **Mendel's Peas Exercise 1 – Part 3** file.

You are working in a company that produces strains of pea plants and ships them out all over the world to research labs. Your company prides itself on supplying only true-breeding pea plants that produce the identical pea plant offspring for many generations. You and your co-worker previously characterized two new **true-breeding** strains of pea plants: one with white flowers and one with purple flowers. Using representative plants from these two strains, ***White Parent 1*** and ***Purple Parent 1***, you previously determined that the purple flower phenotype is dominant to the white flower phenotype. You also characterized a pea plant that appeared on your desk with purple flowers (***Purple Parent 2***) and determined that ***Purple Parent 2*** is not true breeding. All three plants can be found in the **Strains** box in StarGenetics.

You already know that a **single gene** controls flower color. You are not sure if the allele that confers purple flowers in ***Purple Parent 2*** is the same allele that confers purple flowers in ***Purple Parent 1***. To further study the purple allele in ***Purple Parent 2***, you will need to generate a true-breeding strain with purple-flowered plants using ***Purple Parent 2***.

1 Based on the fact that ***Purple Parent 2*** is not true breeding, and the purple flower color of this plant is dominant to the white flower color of ***White Parent 1***, what is the genotype of ***Purple Parent 2*** with

respect to flower color? Assign letters to represent the alleles corresponding to the dominant and recessive phenotypes. Provide an explanation for your genotype nomenclature, making sure to include a description of which phenotype each allele represents.

Answer

Genotype of *Purple Parent 2*:

Description:

2 What are the expected genotypic and phenotypic ratios of the F1 offspring resulting from a self-cross of ***Purple Parent 2***? Fill in the Punnett Square below to determine the expected potential genotypes of the offspring resulting from this cross.

Answer

Expected Genotypic ratio:

Expected Phenotypic ratio:

3 Now perform the cross in StarGenetics (one self-mating for a total of 20 offspring). What is the observed phenotypic ratio? What are the possible genotype(s) of the purple plants and white plants?

Answer

Phenotypic Ratio:

Purple genotype(s):

White genotype(s):

4 You will now create a true-breeding purple strain from ***Purple Parent 2***. Are any of the purple F1 plants in the cross in Question 3 true breeding with respect to flower color? If some of the F1 purple plants ARE true breeding, describe how you could isolate the purple true-breeding plants from the other purple F1 plants and create a true-breeding purple strain from these. If no F1 plants are true breeding, describe the additional crosses you would need perform to generate a true-breeding strain with purple flowers. Use Punnett squares to support your answer.

Answer

Advanced

5 Now, produce a true-breeding strain that has purple flowers and inflated, green pods derived from the ***Purple Parent 3*** plant in your **Strains** box. ***Purple Parent 3*** is heterozygous for all three traits (purple, inflated, green). Include the genotype of ***Purple Parent 3*** and a description of which phenotype each allele represents. You can assume that each trait is controlled by a unique, single gene. Explain how your derived a true-breeding strain from the ***Purple Parent 3*** plant, including a summary of the crosses you performed in StarGenetics and their outcomes in your explanation.

Answer

Genotype of Purple Parent 3:

Description:

Strategy:

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